Bachelor of Science (B.Sc.) **Industrial Chemistry** **Undergraduate**

B. Sc. (UG) Semester – III (Effective from JUNE 2025)

Course Code (Major)	US03MAICH01	**Title of the Course**	Chemical Plant Utilities and Instrumentation
Total Credits of the Course	4	**Hours per Week**	4

Course Objectives:	This course aims to: 1. Provide fundamental knowledge of chemical plant utilities such as water, fuels, air, and steam. 2. Introduce the working principles and applications of equipment used for compression, refrigeration, and power generation. 3. Develop a strong understanding of industrial instrumentation including pressure, vacuum, level, and density measurement techniques.

Course Content		
Unit	**Description**	**Weightage**
1.	Water: Impurities and hardness of natural water, Water for steam making and industrial processes, Boiler water treatments, performing relevant calculations. Fuels: Classification, Advantages and disadvantages, Analysis of fuels, Heating media; Air- Specification of industrial uses of air, Industrial applications of CO_2, O_2, N_2 and H_2	**25%**
2.	Compression Equipment: Working principles of reciprocating compressors, Single-stage and multi-stage compression, volumetric efficiency, and effect of clearance. Refrigeration: COP, refrigerating effect, industrial refrigerants, Carnot and other refrigeration cycles, industrial applications. Internal combustion engines and external combustion engines, Steam power plant, its working and thermodynamic analysis, Otto engine and diesel engine Steam boilers – their classification, steam generation, conditions of steam, Steam table	**25%**
3.	Pressure and Vacuum measurement: Introduction, Pressure measuring instruments, Barometer, Manometers, Elastic Pressure Transducers, Forced balanced pressure gauges, Differential Pressure Measurement	**25%**
4.	Density and Level measurement: Applications, Level measuring methods, Direct level measurement such as Point contact methods, Sight glass method, Buoyancy methods; Indirect level measurement such as Hydrostatic methods, Electrical capacitance method, Radiation method, Ultrasonic level detector	**25%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes

Upon successful completion of the course, students will be able to:
1. Understand the roles and importance of utilities such as water, fuels, air, and steam in chemical industries.
2. Analyze the working of compressors, refrigeration systems, and power engines.
3. Evaluate and apply various pressure, vacuum, level, and density measurement techniques in real industrial scenarios.
4. Perform calculations related to utilities and interpret steam tables and instrumentation data.

Suggested References:

Sr. No.	References
1.	**"Chemical Engineering Volume 6: Chemical Engineering Design"** by R.K. Sinnott and Gavin Towler, Elsevier
2.	**"Industrial Instrumentation and Control"** by S.K. Singh, Tata McGraw-Hill Education
3.	**"A Textbook of Chemical Engineering Thermodynamics"** by K.V. Narayanan, PHI Learning Pvt. Ltd.
4.	**"Introduction to Chemical Engineering"** by Badger and Banchero, Tata McGraw-Hill
5.	**"Boiler Operation Engineering: Questions and Answers"** by P. Chattopadhyay, McGraw-Hill Education
6.	**"Refrigeration and Air Conditioning"** by C.P. Arora, McGraw-Hill Education
7.	**"Process Systems Analysis and Control"** by Donald R. Coughanowr and Steven E. LeBlanc, McGraw-Hill Education
8.	**"Measurement Systems: Application and Design"** by Ernest O. Doebelin and Dhanesh N. Manik, McGraw-Hill

Online Resources:

- Google Books: https://books.google.com
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Bachelor of Science (B.Sc.) **Industrial Chemistry** **Undergraduate**

B. Sc. (UG) Semester – III (Effective from JUNE 2025)

Course Code (Major)	US03MAICH02	**Title of the Course**	Organic Chemistry
Total Credits of the Course	4	**Hours per Week**	4

Course Objectives:	This course aims to: 1. The fundamental concepts of organic chemistry and chemistry of Heterocyclic compounds. 2. Basic knowledge of the stereochemistry.

Course Content		
Unit	**Description**	**Weightage**
1.	Phenols, Alcohols, Ethers, Epoxides and Amines: Structure, Nomenclature, Preparation, Physical properties, Salts of phenol, Acidity of phenols, Reactions. Alcohols: Structure, Classification, Nomenclature, Preparation, Physical properties, reactions, Alcohols as acids and bases, Synthesis using alcohols. Ethers - Structure, Nomenclature, Preparation, Physical properties, Reactions, Cyclic ethers. Epoxides - Preparation and reactions. Amines - Structure, Nomenclature, Preparation & Reactions, Salts of amines, Basicity of amines, Hoffman elimination, Analysis of amines, Diazonium salts -Synthesis, reaction and characteristics.	**25%**
2.	Aldehydes, Ketones, Carboxylic Acids & their derivatives: Structure, Classification, Nomenclature, Preparation, Physical properties, Reactions, Nucleophilic addition reactions, Base promoted halogenation of ketones, Acid catalyzed halogenation of ketones. Salts of carboxylic acids, Acidity of carboxylic acids, Effect of substituents on acidity, reactions of acid chloride, Acid anhydrides.	**25%**
3.	Heterocyclic compounds: Nomenclature of heterocyclic systems, five-member heterocycles - Structure, source and electrophilic substitution reaction in Pyrrole, Thiophene and furan. Six membered heterocycles - Structure and source of pyridine compounds, nucleophilic and electrophilic substitution reaction in pyridine, basicity of pyridine, reduction of pyridine.	**25%**
4.	Stereochemistry: Stereoisomerism, Polarimeter, specific rotation, chirality, enantiomers, diastereomers, meso compound, Racemic modification, optical activity, configuration, specification of configuration: R & S, conformational isomers, reactions involving stereoisomers.	**25%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes

Upon successful completion of the course, students will be able to:

1. To understand and explain the functional behavior of Phenols, Alcohols, Ethers & Epoxides and Amines compounds.
2. To understand preparation, properties and reactions of Aldehydes, Ketones, Carboxylic Acids & their derivatives.
3. To acquire basic knowledge of preparation, properties and reactions of N, O, and S containing heterocyclic compounds.
4. To understand the basic of stereochemistry, physical properties of isomers, and applications of the organic stereochemistry.

Suggested References:

Sr. No.	References
1.	**"Chemistry of Carbonyl Compounds"** by Cautsche, Prentice Hall.
2.	**"Organic Chemistry"** by M. K. Jain & S. C. Jain, Shoban Lal Nagin Chand & Co. Educational Publishers, Jalandhar.
3.	**"Organic Chemistry"** by Robert T. Morrison & Robert T. Boyd, Prentice Hall of India Pvt. Ltd., New Delhi.
4.	**"Organic Chemistry"** by R. K. Bansal, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
5.	**"Stereochemistry of Organic Compounds"** by Samuel H. Wilen, Wiley.
6.	**"Introduction to Stereochemistry"** by Andrew Clark, Royal Society of Chemistry (RSC), 2020.

Online Resources:

- Google Books: https://books.google.com
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Bachelor of Science (B.Sc.) **Industrial Chemistry** **Undergraduate**

B. Sc. (UG) Semester – III (Effective from JUNE 2025)

Course Code (Minor)	US03MAICH03	**Title of the Course**	Industrial Chemistry - Practical
Total Credits of the Course	4	**Hours per Week**	8

Course Objectives:	This course aims to: 1. Provide foundational skills in chemical and water analysis relevant to industrial applications. 2. Introduce students to inorganic qualitative analysis for identification of basic cations and anions. 3. Develop competency in identifying functional groups in simple organic compounds using systematic procedures.

Course Content

Part I: Water Analysis and Applied Chemistry (Credits: 02 | Hours per Week: 04)

1. Determination of Hardness of Water by EDTA Method
   - Aim: To determine total, temporary, and permanent hardness of natural or industrial water using complexometric titration.

Part II: Qualitative Organic Analysis (Credits: 02 | Hours per Week: 04)

1. Organic Qualitative Analysis of Binary Mixture
   - Aim: Identification of functional groups and compound classes by characteristic reactions.
   - Techniques: Separation, purification (solvent extraction, distillation, recrystallization).

Teaching-Learning Methodology	Hands-on laboratory work guided by demonstrative sessions, Use of ICT tools: PowerPoint presentations, visual simulations, and e-resources, Engagement through lab manuals, model-based learning, and peer discussion, Compliance with inclusive education and NEP-2020 guidelines for laboratory pedagogy.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	**Internal Practical Examination** [Continuous Evaluation System (CES) (Attendance, Journals, Quizzes, Practical Records, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Examination** [University Practical Examination] (as per NEP-2020)	**50%**

Note: Assessment will be maintained through observation of performance, attendance, viva voce, and record submission.

Course Outcomes
Upon successful completion of the course, students will be able to: 1. Perform standard water hardness tests relevant to industrial specifications. 2. Apply semi-micro techniques to identify inorganic salts through systematic analysis. 3. Recognize and identify functional groups in unknown organic binary mixtures using standard laboratory techniques.

Suggested References:

Sr. No.	References
1.	**"Chemistry for Degree Students (First Year)"** by **R.L. Madan**, **S. Chand Publishing**, 3rd Edition, 2011. ISBN: 978-8121932301
2.	**"Inorganic Chemistry"** by **Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller & Fraser Armstrong**, **Oxford University Press**, 5th Edition, 2010. ISBN: 978-0199599608
3.	**"Vogel's Textbook of Practical Organic Chemistry"** by **Brian S. Furniss**, **John Wiley & Sons**, 5th Edition, 1989. ISBN: 978-0582462366

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Bachelor of Science (B.Sc.) **Industrial Chemistry** **Undergraduate**

B. Sc. (UG) Semester – III (Effective from JUNE 2025)

Course Code (Inter-Disciplinary)	US03SEICH01	**Title of the Course**	Industrial Pollution and Safety
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives:	This course aims to: 1. Sources of Industrial air pollution, adverse effect of air pollutant, Air and noise pollution controlling techniques. 2. Sources of Industrial water pollution, types and adverse effect of water pollutant, waste water treatment.

Course Content

Unit	Description	Weightage
1.	Atmosphere, Ecosystem, and Air Pollution: Composition of atmosphere, structure of ecosystems, sources and effects of air pollutants (CO, SO_2, NOx, particulates, hydrocarbons), greenhouse effect and global warming, air pollution control methods (cyclones, scrubbers, electrostatic precipitators), noise pollution and its control.	**50%**
2.	Water Pollution and Environmental Toxicology: Sources of water pollution (industrial, domestic, agricultural), classification of pollutants, effects on human health and aquatic systems, wastewater treatment (primary, secondary, tertiary), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pesticide pollution, sound pollution overview.	**50%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes
Upon successful completion of the course, students will be able to: 1. Describe the structure of the atmosphere and ecosystem along with various types and sources of pollution. 2. Analyze the effects of major pollutants on human health and the environment. 3. Explain techniques used for controlling air and noise pollution in industrial setups. 4. Interpret pollution parameters such as BOD and COD in wastewater treatment. 5. Appreciate the role of environmental policies and sustainable practices in industry.

Suggested References:

Sr. No.	References
1.	**"Environmental Chemistry"** by **A.K. De**, **New Age International Publishers**, 9th Edition, 2019. ISBN: 978-9389335939
2.	**"Environmental Studies"** by **Erach Bharucha**, **University Grants Commission, India**, 2nd Edition, 2013. ISBN: 978-8173718165
3.	**"Principles of Environmental Science"** by **William P. Cunningham and Mary Ann Cunningham**, **McGraw Hill Education**, 8th Edition, 2014. ISBN: 978-0073532516
4.	**"Environmental Pollution Control Engineering"** by **C.S. Rao**, **New Age International Publishers**, 2nd Edition, 2006. ISBN: 978-8122418354
5.	**"Introduction to Environmental Engineering and Science"** by **Gilbert M. Masters and Wendell P. Ela**, **Pearson Education**, 3rd Edition, 2007. ISBN: 978-0131481930
6.	**"Wastewater Engineering: Treatment and Resource Recovery"** by **Metcalf & Eddy**, **McGraw Hill Education**, 5th Edition, 2014. ISBN: 978-1259010798

Online Resources:

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Bachelor of Science (B.Sc.) Industrial Chemistry Undergraduate

B. Sc. (UG) Semester – III (Effective from JUNE 2025)

Course Code (Inter-Disciplinary)	US03IDICH01	**Title of the Course**	Industrial Utilities and Energy Systems
Total Credits of the Course	2	**Hours per Week**	2

Course Objectives:	This course aims to: 1. Introduce fundamental industrial utilities such as water, fuels, air, and steam. 2. Explain the characteristics and applications of industrial gases and heating media. 3. Familiarize students with mechanical and thermal energy systems used in industry including compressors, engines, and boilers. 4. Provide an understanding of energy efficiency through thermodynamic principles and performance analysis. 5. Equip students with skills to apply theoretical knowledge to real-world utility systems in chemical industries.

Course Content

Unit	Description	Weightage
1.	Water: Impurities and hardness of natural water, Water for steam making and industrial processes, Boiler water treatments, performing relevant calculations. Fuels: Classification, Advantages and disadvantages, Analysis of fuels, Heating media; Air- Specification of industrial uses of air, Industrial applications of CO_2, O_2, N_2 and H_2.	**50%**
2.	Compression Equipment: Working principles of reciprocating compressors, Single-stage and multi-stage compression, volumetric efficiency, and effect of clearance. Refrigeration: COP, refrigerating effect, industrial refrigerants, Carnot and other refrigeration cycles, industrial applications. Internal combustion engines and external combustion engines, Steam power plant, its working and thermodynamic analysis, Otto engine and diesel engine Steam boilers – their classification, steam generation, conditions of steam, Steam table	**50%**

Teaching-Learning Methodology	Courses for B.Sc. Industrial Chemistry programs are delivered through conventional blackboard teaching and supported by ICT tools such as PowerPoint presentations, audio-visual content, e-resources, seminars, workshops, and demonstration models. These methods aim to provide an inclusive and engaging learning environment in alignment with NEP-2020.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	**Internal Theory Examination** [Continuous Evaluation System (CES) (Attendance, Quizzes, Active Participation) (As per NEP-2020)]	**50%**
2.	**External Theory Examination** [University Theory Examination] (as per NEP-2020)	**50%**

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Identify and describe industrial water treatment methods and fuel analysis procedures.
2. Explain the working and application of compressors, boilers, and refrigeration systems.
3. Analyse engine and steam systems using thermodynamic principles.
4. Demonstrate awareness of industrial applications of gases and air systems.
5. Apply process calculations and energy efficiency concepts in industrial utility systems.

Suggested References:	
Sr. No.	**References**
1.	**"Engineering Chemistry"** by S. S. Dara & S. S. Umare, S. Chand & Company.
2.	**"Chemical Process Calculations"** by K. Asokan, PHI Learning Pvt. Ltd.
3.	**"Thermal Engineering"** by R. K. Rajput, Laxmi Publications.
4.	**"Industrial Chemistry"** by V. V. Mahajani & S. B. Umarji, Oxford University Press.
5.	**"Steam Boilers and Engines"** by O. P. Gupta, Khanna Publishers.
6.	**"Unit Operations of Chemical Engineering"** by W. L. McCabe, J. C. Smith & P. Harriott, McGraw-Hill.

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